

## PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY  
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference MTC024BWO	<b>FOR FURTHER ACTION</b> See Form PCT/PEA/416	
International application No. PCT/EP2004/000232	International filing date (day/month/year) 15.01.2004	Priority date (day/month/year) 29.01.2003
International Patent Classification (IPC) or national classification and IPC B01J8/04		
Applicant METHANOL CASALE S.A.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 2 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand  20.08.2004	Date of completion of this report  27.04.2005	
Name and mailing address of the international preliminary examining authority:   European Patent Office - Gitschiner Str. 103 D-10958 Berlin Tel. +49 30 25901 - 0 Fax: +49 30 25901 - 840	Authorized Officer  Gruber, M  Telephone No. +49 30 25901-336  	

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/EP2004/000232

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1, 2, 4-10 as originally filed  
3 filed with telefax on 29.11.2004

**Claims, Numbers**

2-7 as originally filed  
1 filed with telefax on 29.11.2004

**Drawings, Sheets**

1/2-2/2 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/EP2004/000232

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	1-7
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	1-7
Industrial applicability (IA)	Yes: Claims	1-7
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Reference is made to the following documents:

D1: US-A-4 769 220 (ZARDI UMBERTO) 6 September 1988 (1988-09-06)  
D2: US-A-5 035 867 (DANG VU QUANG ET AL) 30 July 1991 (1991-07-30)

- 1 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1 to 7 does not involve an inventive step in the sense of Article 33(3) PCT.
- 1.1 The document **D2** is regarded as being the closest prior art to the subject-matter of claims 1 and 7, and discloses (the references in parentheses applying to this document) a cylindrical reactor (1), the reactor comprises a plurality of plate shaped heat exchangers being vertically divided into two sections and which are connected by manifolds so that the exchange of liquid between the sections is enabled, the plate shaped heat exchangers are embedded in a catalyst bed that is itself held in a permeable basket, the catalyst bed and the heat exchanger plates are disposed such that the reagents pass through the bed perpendicularly to the axis of the reactor (ref. col. 6, lines 20 to 25).

The subject-matter of claims 1 and 7 **differs** from this known piece of prior art only in that the catalyst bed is vertically divided into two sections.

The claimed advantage of this difference, i.e. a better control of the temperature in the catalyst bed, is considered obvious for the person skilled in the art as even with a single bed as in D2, the temperature of different parts of the bed can be closely controlled by the different sections of the vertically divided heat exchanger. Dividing also the catalyst bed into two sections as in claims 1 and 7 is not considered to bring any further (non obvious) advantage with regard to temperature control.

- 1.2** For the sake of completeness, it is submitted that in another piece of prior art, i.e. D1, which is technically very close to the claimed invention, discloses a reactor with vertically divided heat exchange and catalyst bed sections. However, in contrast to claims 1 and 7, the heat exchangers are not embedded in the catalyst bed but positioned in the central void spaces of the catalyst beds which have the form of a hollow cylinders.
- 1.3** The subject matter of claims 3 to 6 is disclosed in D2, the one of claim 2 in D1. Consequently, no inventive activity can be acknowledged for the subject matter of these claims.

Said crossing speed negatively influences the heat exchange coefficient between reactants and heat exchange plates.

For these reasons optimal control of the pseudo-isothermicity of the reaction is no longer possible.

5 Summary of the invention

The technical problem underlying the present invention is that of realising a chemical reactor of the aforementioned type having structural and functional characteristics such as to allow effective control of the pseudo-isothermicity  
10 of the reaction so as to overcome the drawbacks of the prior art described above.

The aforementioned technical problem is solved by a pseudo-isothermal radial chemical reactor for catalytic reactions, comprising a substantially cylindrical shell closed at the  
15 opposite ends by respective base plates, a reaction zone comprising a respective catalytic bed and a plurality of heat exchangers placed in said respective catalytic bed, characterised in that it comprises at least one second  
20 further reaction zone comprising a respective catalytic bed and a plurality of heat exchangers placed in said respective catalytic bed of said second reaction zone, said first and said second reaction zone being in fluid communication with each other.

Further characteristics and advantages of the invention  
25 will become clearer from the detailed description of an embodiment of a chemical reactor according to the invention, given hereafter with reference to the attached drawings, for indicative and non-limiting purposes.

EPO - DG 1

07. 12. 2004

(62)

## CLAIMS

(62)

1. Pseudo-isothermal radial chemical reactor for catalytic reactions, comprising a substantially cylindrical shell (2) closed at the opposite ends by respective base plates (3 and 4), a reaction zone (8) comprising a respective catalytic bed (11) and a plurality of heat exchangers (22) placed in said respective catalytic bed (11), characterised in that it comprises at least one second further reaction zone (26) comprising a respective catalytic bed (29) and a plurality of heat exchangers (36) placed in said respective catalytic bed (29) of said second reaction zone (26), said first and said second reaction zone (8 and 26) being in fluid communication with each other.
2. Chemical reactor according to claim 1, characterised in that said first and said second reaction zone (8 and 26) are associated in series.
3. Chemical reactor according to claim 2, characterised in that the plurality of heat exchangers (22) of at least one of said reaction zones (8, 26) is in fluid communication with the outside.
4. Chemical reactor according to claim 3, characterised in that the pluralities of heat exchangers (22, 36) of both of said reaction zones (8, 26) are in fluid communication with each other.
5. Chemical reactor according to claim 4, characterised in that at least one exchanger of said pluralities of heat exchangers (22, 36) is plate-shaped, rectangular and boxed.
6. Chemical reactor according to claim 5, characterised in that said plurality of exchangers (22) is arranged